Pharmacology, by James Longrigg, from *Greek Medicine from the Heroic to the Hellenistic Age, a Source Book* (New York, 1998).
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Wikipedia has a series of entries on the history of pharmacy.

XIII

Pharmacology

Our earliest literary evidence for the medical use of plants and their properties in Ancient Greece comes from Homeric Epic.

MEDICAL USE OF PLANTS IN HOMER

XIII.1. Homer, *Iliad* 11.844-8

Here Patroclus applies a pain-killing and styptic drug to Eurypylus's arrow wound.

Then Patroclus stretched him out and with a knife cut from his thigh the sharp, piercing arrow, and from the wound washed away the black blood with warm water. He cast upon it a bitter pain-killing root, after rubbing it in his hands, which stayed all his pains. The wound dried up and the blood ceased.

XIII.2. Homer, *Iliad* 5.900-4

The divine healer treats the god, Ares, with pain-killing drugs when wounded by Diomedes.

Paëon spread pain-killing drugs upon his wound and healed him. For he was in no respect mortal. Even as when the juice of the fig speedily congeals the white milk, though it is liquid ... even so swiftly he healed furious Ares.

XIII.3. Homer, *Odyssey* 4.220ff.

Helen gives her guests a powerful Egyptian tranquilliser.

Into the wine of which they were drinking Helen cast a drug that banished sorrow and anger and made one forgetful of all ills. Whoever drank it down, when it had been mixed in the wine-bowl, could not shed a tear that day down his cheeks, not even if his mother and his father died, not even if his brother or beloved son was slain by the sword in his presence, and he saw it with his own eyes. Such were the helpful and potent drugs possessed by the daughter of Zeus that the wife of Thon gave her, Polydamna from Egypt, where the fertile soil produces the greatest number of drugs, many good in compounds, but many poisonous. Every man is a doctor there and skilled beyond all men.

Egyptian drugs continued to be employed in classical and Hellenistic times.

XIII.4. Homer, *Odyssey* 10.286ff.

The magical powers with which some drugs were invested are most clearly evident in the *Odyssey*. Here Hermes provides Odysseus with an antidote to Circe's drugs.

Come, then, I'll get you out of your troubles and save you. Here, take this good drug and go into Circe's house. It will give you power against an evil day. I shall tell you all the malevolent guiles of Circe. She will make for you a pottage and put drugs in the food. But even so she will not be able to enchant you, for this good antidote that I shall give you will not allow her .... So spoke Argeïphontes, and he gave me a herb he had plucked from the ground and explained its nature to me. It was black at the root, but had a milky-white flower. The gods call it moly. It is hard for mortal men to dig up; but the gods have power to do all things.

HIPPOCRATIC PHARMACOLOGY

Significantly the Hippocratic writers do not mention the superstitious beliefs and rituals which invested the collection of plants for medical use. Nowhere are these plants invested with supernatural or magical properties.

XIII.5. [Hippocrates], *Places in man* 39 (VI.328,16-340,1L)

Here mandrake is recommended for use in the treatment of the sick and depressed, those who contemplate suicide, and in the treatment of spasms –

One should give the sick and depressed and those who wish to hang themselves an infusion of mandrake-root to drink early in the day of a lesser dosage than would cause delirium.

One should treat spasm in the following manner: kindle a fire on either side of the bed and give the patient to drink an infusion of mandrake-root, less in dosage than would cause delirium, and apply to the Achilles tendons hot poultices. If fever supervenes from the spasm, it ceases on the same day, on the next day or on the day after.

XIII.6. [Hippocrates], *Diseases* II.43 (VII.60,6-21L)

– and here as an ingredient, along with hellebore, in a compound to be administered in cases of quartan fever.

Whenever a quartan fever takes hold, if it attacks someone unpurged of another disease, give him a medicine to drink to purge him downwards. Then to purge his head. Then give him another draught to purge him downwards again. If the fever does not abate when he has done these things, leaving an interval of two seizures after the downward purging, wash him in copious hot water and give him to drink as much of the fruit of henbane as is the equivalent of a single grain of millet seed, an equal amount of mandrake, three beans of fig-juice, and a like amount of trefoil in unmixed wine. If he is vigorous and seems to be in good health, but has fallen into a fever as a result of fatigue or a journey, and the fever becomes quartan, give him a vapour-bath and then garlic dipped in honey. Then let him drink afterwards a mixed potion of lentils, honey, and vinegar. When he is full, let him vomit. Then, wash him in warm water and when he has cooled down, let him drink a posset in water. Towards evening let him take soft foods in small amounts. On the next seizure wash him in warm water, pile cloaks upon him until he perspires, then give him to drink straightaway the equivalent of three fingers' length of the root of white hellebore, a drachma's size of trefoil and two beans of fig-juice in unmixed wine ....

XIII.7. [Hippocrates], *Nature of woman* 2 (VII.312,14-314,13L)

A variety of drugs is here employed in the treatment of dropsy in the womb.

If dropsy occurs in the womb, menstruation becomes less and causes more trouble; then it ceases suddenly and the stomach becomes swollen and the breasts dry; the woman is in other respects in a bad state and imagines she is pregnant. By these symptoms you will recognise that she is suffering from dropsy. The *os uteri* also provides an indication: for it appears dry to the touch. Fever and dropsy take the patient. Pain of ever-increasing severity takes hold of the lower belly, the loins and the flanks. This disease comes about especially after a miscarriage, but also from other causes. Whenever this is the case, one should wash the woman with warm water and apply warm fomentations where she has pain. One should administer a purgative and, after the purgative, fumigate her womb in a cow-dung vapour-bath. Then insert a pessary made with cantharid beetle, and, after three days, a pessary made of bile. After an interval of one day, let her douche herself with vinegar for three days. Then if her belly empties and the fevers have ceased and menstruation supervenes, let her lie with her husband. If not, let her repeat the same procedures until menstruation occurs and employ some suppositories. In the intervening days let her drink a potion of samphire-bark and black seeds of peony and the fruit of elder in wine on an empty stomach. Let her eat as much garden-mercury as possible, and garlic, both boiled and raw. Have her eat soft foods, octopus and other soft animals. If she gives birth she recovers her health.

For drugs used to treat dislocation of the womb, see **XVI.12** below.

PHARMACOLOGY IN THE FOURTH CENTURY

Plato

XIII.8. Plato, *Timaeus* 89B-D

Plato's hostility towards the use of drugs.

Diseases, except where they are very dangerous, should not be irritated by drugs. For every disease has a structure that resembles in a certain manner the nature of living creatures. For the composition of these living creatures has prescribed periods of life for the species as a whole .... It is the same with the constitution of diseases: whenever anyone destroys this by drugs, contrary to the allotted period of time, many serious diseases are wont to arise from those that are few and slight. Consequently, so far as leisure permits, one should control all such diseases by regimen, instead of irritating a troublesome evil by administering drugs.

Diocles

Diocles seems to have been the first to write a herbal on the medical use of plants. Unfortunately only very brief fragments of this work have survived.

Theophrastus

The important botanical research carried out by Theophrastus was influential throughout antiquity.

XIII.9. Theophrastus, *History of plants* 9.5

Unlike the Hippocratics, Theophrastus explicitly cites botanical folk-lore. Here he records the dangers attendant upon the collection of thapsia.

<Herbalists and root-cutters> enjoin that in cutting some roots one should stand to windward, for example, in cutting thapsia among others, and that one should first anoint oneself richly with oil; for, if one stands to leeward, one's body will swell up.

XIII.10. Theophrastus, *History of plants* 9.6

And the perils in peony-collecting.

<They say> that the peony, which some call the *glycyside*, should be dug up at night, for, if one does it in the day-time, and is observed by a woodpecker while gathering the fruit, one risks the loss of one's eye-sight, but if one is cutting the root at the time, one gets prolapse of the anus.

XIII.11. Theophrastus, *History of plants* 9.8

He records some procedures recommended for the collection of mandrake.

One should thrice draw circles round the mandrake and cut it facing west. One should dance in circles round the second piece cut and say as much as possible about sex.

XIII.11B. Dioscorides, *On medical materials* IV.75 (Vol. II, pp. 233-7 Wellmann, 1906-14)

Dioscorides of Anazarbus (fl. AD 50-70) wrote during the reign of Nero a *Materia medica* that superseded all earlier botanical treatises. It was translated into Latin at least by the sixth century and into Arabic by the ninth, and exercised a great influence upon Islamic, Mediaeval, and Renaissance botany and therapy. Here is Dioscorides on the mandrake. (Although strictly outside the chronological parameters of this book, in view of the importance attached to this plant in the ancient world this context has been included on grounds of general interest.)

Some call it animimon, bombchylon or circaea for the root seems to be good for making philtres. There is a female variety which is black called thridacias. It has leaves that are narrower and smaller than those of the lettuce. They have a foul and heavy odour, and spread out over the ground. Along the leaves there are fruits that resemble the sorb-apple, being yellow and of pleasant smell. In them is the seed, which is like that of the pear. The roots are large, two or three in number and intertwined, black on the surface, white within. The bark is thick and there is no stalk.

The white male variety, which some have called morion, has large, flat, and smooth white leaves, like those of the beet. Its fruit is twice as large, saffron in colour, and of pleasant, but heavy, odour. Shepherds eat it and become somewhat drowsy. The root is like that just described, but larger and whiter. The variety is also without a stalk.

The bark of the root, when tender, gives juice when beaten and placed under a press. The juice must then be fermented in the sun and, after being condensed, must be stored in an earthen vessel. The fruit also gives juice in a similar way, but the juice extracted is diluted. The bark of the root is stripped off, pierced with a thread, and hung up for storage. Some boil down the roots in wine to a third of their original size, and after filtering it, store away the product. They administer a cyathos[1] of it to insomniacs, to those in severe pain, or to those whom they wish to anaesthetise during an operation involving cutting or cautery.

Two obols[2] of the juice, when drunk with melicraton,[3] brings up phlegm and bile, as hellebore does. It is fatal if drunk in larger quantities. It is used as a component in eye medicines, anodynes, and soothing pessaries. But an application of as much as half an obol of it unmixed brings on menstrual flow and expels the embryo. Inserted as a suppository in the anus it causes sleep ....

Fresh leaves of this plant when applied as a plaster with barley are good for inflammations of the eyes and those upon ulcers. It disperses all hardness and abscesses, glandular swellings, and tumours. If rubbed on gently for five or six days it causes branded marks to disappear without ulceration. Its leaves preserved in brine are set aside for the same purposes. The root, rubbed smooth with vinegar, heals erysipelas, but for snake bites is used with honey or oil. It disperses glandular swellings and tumours when used with water, and, in combination with barley, gives relief from pains of the joints.

Wine from the bark of the root is also prepared without boiling. One should place three minas into a metretes[4] of sweet wine and give three cyathoi of this preparation to those who are about to be operated upon with knife or cautery, as has been said. For, being overcome by sleep, they do not feel the pain. Again, the fruit, when eaten or smelled, causes drowsiness, as does the juice of the fruit. Taken in excess it causes loss of speech.

When drunk the seed of the fruit purges the womb; applied as a pessary with native sulphur it stops the red discharge. A muddy liquor is extracted when the root is grooved around, and the flow is caught in the hollow. But the <pressed out> juice is stronger than this liquor. Roots, as experience reveals, do not yield liquor at every point.

Some record another variety called morion growing in shady places and around caves, with leaves like those of white mandragora but smaller, about a span in length, white, and falling in a circle around the root which is tender and white, a little longer than a span, and the thickness of a thumb. They say that when so much as a single drachma[5] of this is drunk or eaten with barley on a cake or in a sauce it causes stupefaction. For, in whatever form a person consumes it, he remains asleep and unconscious of everything for three or four hours from the time it was taken. Physicians use this, too, when they are about to cut or cauterise. They say that the root, when drunk together with thorn-apple, is also an antidote against what is called madness.

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[1] About half a pint.

[2] An obol was about one fortieth of an ounce in the Attic system; about one thirtieth in the Aeginetan.

[3] A mixture of honey and milk or water.

[4] The mina was about a pound in the Attic system; the metretes about nine gallons.

[5] About a sixth of an ounce.

XIII.12A. Theophrastus, *History of plants* 9.8

The collection of black hellebore was also considered to be fraught with danger as is recorded here by Theophrastus.

One should draw a circle round the black hellebore and cut it facing east and saying prayers and one should look out for an eagle both from right and left; for there is a danger to the cutters of dying within the year, if the eagle should come near.

XIII.12B. Theophrastus, *History of plants* 9.10

Here Theophrastus provides a detailed description of hellebore and its effects. The name, as he points out here, is applied to two unrelated plants: Black hellebore (*Helleborus cyclophyllus*), better known as the Christmas Rose, which is a Ranunculacea, and White hellebore (*Veratrum album*), a member of the lily family. Both are poisonous. Black hellebore served as an all-purpose drug for the Greeks and was employed especially for its emetic and diarrhoetic effect. The danger of hellebore was recognised by the Hippocratics (see *Aphorisms* IV.16, IV.506L).

The black and the white hellebore seem as it were to have the same name. But there is disagreement concerning the appearance of the plants. Some say that the two are alike, except that they differ only in colour, the root of the one being white and of the other black. Some say that the leaf of the black resembles that of the bay and that of the white is like that of the leek, but the roots are alike except for their colours. Those, then, who say that they are alike describe their appearance as follows: the stem is like that of asphodel and is very short; the leaf has broad divisions, and is very like that of the ferula, but is long; it has radical leaves flat on the ground; it has many roots, the slender ones are very useful.

They say that the black is fatal to horses, oxen and pigs, on which account none of these animals feeds upon it. The white, however, is eaten by sheep and from this its property was first observed; for they are purged by it. It is in season in the autumn and out of season during the spring. However, the people from Mt. Oeta gather it about the time of the meeting of the Amphictyons[1] at Pylae, for it grows there best and in greatest abundance, but at one place only in Oeta ....

Black hellebore grows everywhere. It grows in Boeotia, in Euboea, and in many other places. The best is that from Mt. Helicon – the mountain, in general, is rich in herbs. The white is found in few places. The best and most used comes from four places, Oeta, Pontus, Elea and Malea. They say that from Elea grows in the vineyards and makes the wine so diuretic that those who drink it are very emaciated.

Best of all these and the rest is that from Oeta. That from Parnassus and from Aetolia (for it grows there too and many buy and sell it in their ignorance) is bitter and excessively harsh. These plants, then, though resembling the best in their appearance, differ in their properties.

Some call the black 'Melampus's hellebore' on the grounds that he was the first to cut and discover it. They also purify houses and sheep with it, chanting some incantation at the same time. They also employ it for several other purposes.

[1] These meetings were held regularly in the autumn and sometimes in the spring. The spring meeting is implied here.

ALEXANDRIAN PHARMACOLOGY

XIII.13. Cornelius Celsus, *On medicine* V.1 (*CML* I, p. 190 Marx = *Herophilus* Fr. 251 von Staden)

The Alexandrians maintained this interest in the healing properties of drugs.

I have spoken about those ills of the body for which the regulation of diet is especially helpful; now I must pass on to that part of medicine that counters them more by drugs. The ancient authors attributed much to these drugs, both Erasistratus and those who call themselves Empiricists, but especially Herophilus and the followers of that famous man, to such an extent that they did not treat any kind of disease without drugs.[1] They also handed down many things about the properties of drugs such as are found in the works of Zeno or Andreas or Apollonius surnamed Mus.

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[1] Celsus's claim here is somewhat exaggerated since we learn elsewhere ([Galen], *On easily acquired remedies* 2.13 XIV.444K) that Herophilus treated consumption solely by dietary means.

XIII.14. Marcellus, *Letter of Cornelius Celsus On remedies* (*CML* V.36 Niedermann/Liechtenhan = *Herophilus* Fr. 248b von Staden)

Drugs as 'the hands of the gods'.

Herophilus, who was once held to be among the greatest physicians, is held to have said that drugs are the hands of the gods, and indeed, not without reason, in my opinion. For, in a word, what divine touch can effect, drugs tested by use and experience also accomplish.

XIII.15. Pliny, *Natural history* 25.23.57-8 (= *Herophilus* Fr. 255 von Staden)

The effects of hellebore.

<Herophilus> used to liken hellebore to a very brave captain; for, when it has stirred up everything within, it sallies out first in the van.

Elizabethan superstitions

The Elizabethans shared the same superstitions regarding the collection of certain drugs.

XIII.16. *Romeo and Juliet* Act IV, Scene 3

The dangers attendant upon the picking of mandrake …

> And shrieks like mandrakes torn out of the earth,
> that living mortals, hearing them, run mad.

XIII.17. John Gerarde, *The Herball or Generall Historie of Plants*, 1597, p. 281

... were such that a dog was used to pull out the plant.

They fable further and affirm that he who woulde take up a plant <i.e. of mandrake> thereof must tie a dogge[1] thereunto to pull it up, which will give a great shrike at the digging up; otherwise if a man should do it, he should certainly die in a short space thereafter.

[1] An illustration in the Juliana Anicia Codex (sixth century AD) depicts the nymph Discovery presenting a mandrake to Dioscorides. The mandrake is still tied to a dog whose life has been sacrificed to obtain it.

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The use of inorganic and organic substances, particularly of plants, for medical purposes antedates recorded history. Information concerning drugs had been accumulated over many centuries by collectors of herbs and root-cutters, who had tested many plants, assessed their various powers and devised elaborate means for their collection. Doubtless these prescriptions and rituals that attended their gathering were intended as much to invest these plants with a particular mystique (which would thereby accentuate the placebo-effect) as to increase their value in the market-place by stressing the difficulties and dangers involved in their collection. Mandrake,[1] for example, was invested with a superstitious ritual that remained in vogue at least until Elizabethan times. See, for example, *Romeo and Juliet* Act IV Scene 3 **[XIII.16]**, where is recorded the belief that the plant screamed when dragged from the earth. Such was the danger attendant upon picking it that it had to be done by tying it to a dog, whose life was forfeit **[XIII.17]**. Theophrastus preserves tales recording similar dangers investing the gathering of herbs, for example, the cutting of thapsia **[XIII.9]**, the peony **[XIII.10]**, mandrake **[XIII.11]**, and hellebore **[XIII.12]**. The properties of many plants, then, were known by root-cutters (*rhizotomoi*) and herbalists who, while observing all manner of superstitious practices in their work, nevertheless transmitted to posterity a rich treasury of herbal lore.

Our earliest literary source of evidence for the medical use of plants and their properties (real or imaginary) is, again, Homeric Epic. Many passages, especially in the *Iliad,* refer to the application, of pain-killing drugs – often derived from plants – to wounds sustained in battle. For example, at *Iliad* 4.210-19 **[XV.3]** Machaon spreads upon Menelaus's arrow-wound soothing drugs (*pharmaka*) that Chiron once gave to his father, and at *Iliad* 11.822-36 **[XV.2]** the wounded Eurypylus asks Patroclus to sprinkle upon his wound healing drugs he has learned from Achilles. Patroclus, we are told, after cutting out the arrow from Eurypylus's thigh, applied to the wound a bitter pain-killing root, which dried up the wound and stopped the blood **[XIII.1]**. Even when the gods were wounded their treatment was not dissimilar. When Ares was wounded by Diomedes, he was treated by the divine healer, Paëon, who spread pain-killing drugs upon his wound that acted 'like rennet curdling milk' and swiftly cured him **[XIII.2]**. In the *Odyssey* **[XIII.3]** Helen, the wife of Menelaus, laced the wine she gave to her guests, Telemachus and Peisistratus, the son of Nestor, with a powerful Egyptian tranquilliser. The magical power with which some drugs were invested is clearly apparent in

Odysseus's encounter with Circe in the eleventh book of the *Odyssey*. Here Odysseus is given an antidote by Hermes to counter the drug used by Circe to turn men into animals **[XIII.4]**.

It is clear from the title of a play by Sophocles, of which only fragments survive, that the term *rhizotomoi* ('root-cutters') was applied by the fifth century, at least, to those concerned with the collection of plants for medicinal purposes. The root-cutters are also frequently associated with drug-sellers (*pharmakapôlai*) and it seems likely that the same individuals engaged in both the collecting and selling of medicines derived from plants, which were by far the most frequently employed in Greek pharmacology. The doctors, too, seem to have compounded their own drugs, and the treatise entitled *rhizotomikon* attributed later to Diocles of Carystus (see below) seems also to point to the likelihood of overlapping activity here.

The Hippocratic *Corpus* preserves much evidence of the medical use of plants. Many of the pharmacological texts appear as appendages to the gynaecological treatises. It is significant that these Hippocratic writers refrained from mentioning in their accounts of particular plants the superstitions and folk-beliefs so frequently in evidence elsewhere and, on no occasion, are these plants invested with supernatural or magical properties. Mandrake, for example, is recommended in several gynaecological treatises for use as a potion, pessary or clyster **[XIII.5]**, and in *Diseases* II.43 it is prescribed as part of a compound of several ingredients for cases of quartan fever **[XIII.6]**; but nowhere do we find any indication of the superstitious rituals to be followed during its collection, which can be found in other authors. This silence is in strict conformity with the rationalist outlook that pervades the *Corpus* generally. However, as Lloyd points out,[2] the Hippocratics' use of particular plant substances and the manner in which they used them may reflect existing folklore.

Plato reveals himself in the *Timaeus* more hostile to the use of drugs and maintains that one should resort to them only at times of dire necessity, preferring treatment by means of exercise and regimen **[XIII.8]**. The Lyceum, in contrast, provides valuable information concerning plants and their uses acquired as part of the programme for the systematisation of knowledge carried out there. Although there are numerous botanical references in Aristotle's works and he himself on two occasions refers to his own botanical work, there are no extant studies to match those of his zoological treatises.[3] (Because of its Peripatetic style and structure, the treatise *On plants* in two books, which has survived via an Arabic translation from Syriac, subsequently translated into Latin by Alfred of Sareshel, and then re-translated into Greek by Maximus Planudes in the thirteenth century, was erroneously regarded by the majority of Renaissance botanists as having been written by Aristotle himself. Its true author, however, is now generally accepted to have been Nicolaus of Damascus. Apart from the herbals deriving from Dioscorides and Pseudo-Apuleius, this work became the most important single source for later mediaeval botany.)

The first herbal on the medical use of plants seems to have been composed by Diocles of Carystus. The work has been lost but surviving fragments suggest that it contained short descriptions of plants[4] and their natural habitats together with a listing of their medical applications. However, the most important and influential botanical research carried out at the Lyceum, and, indeed, throughout antiquity, was that of Theophrastus, whose works were written within a similar framework to that of Aristotle's zoological treatises. The *Causes of plants*, which corresponds to Aristotle's *Parts of animals*, deals with aitiology, while the *History of plants* is concerned with description, analysis and classification. The ninth book of the latter work reveals Theophrastus's interest in the medical use of plants, and much of the information assembled there seems to have been derived from earlier herbals – perhaps including that of Diocles, as some scholars have suggested. This book differs from the rest in that it contains a mass of folk-lore **[XIII.9-12]** and much more information concerning the herb-gatherers or rhizotomists, some of whom are mentioned by name. Although well aware of the unreliability of these drug-sellers and root-cutters, Theophrastus was disinclined to reject their stories about the potent effects of drugs out of hand and was prepared to accept the possibility that, however fanciful, they might contain at least a grain of truth. Here he stands in marked contrast with the seemingly rational pharmacologies of the Hippocratics, who, as Lloyd well points out,[5] had professional reasons for seeking to distance themselves from other sorts of healers.

As Celsus records **[XIII.13]**, the Alexandrians continued this interest in the healing properties of drugs, both simple and compound. Herophilus is said to have described them as 'the hands of the gods' **[XIII.14]**. His *bon mot* preserved by Pliny describing the effect of hellebore is worth recording here **[XIII.15]**. Among later Herophileans interested in herbals were Zeno, Mantias, Andreas of Carystus and Apollonius Mus.[6] Although our surviving evidence of early Alexandrian pharmacology is only fragmentary, it is sufficient to reveal that, unlike the Hippocratics who are exasperatingly vague in the amounts of the ingredients they prescribe, the Alexandrians were much more precise in specifying the measures to be employed.

[1] The resemblance of the mandrake root to the human form, both male and female, doubtless fostered the superstitions that surrounded it. It contains atropine and was used as an anaesthetic. It was also used in compounding aphrodisiacs [see **XIII.11**].

[2] See Lloyd, 1983, p. 132.

[3] Alexander, referring (*Commentary on Aristotle's treatise On sensation* 183) to a work by Theophrastus *On plants,* declares that there was no botanical work by Aristotle extant. (On this matter, which has aroused some controversy among scholars, see, especially, Senn, 1930, pp. 113-40 and Regenbogen, 1937, pp. 474-5.)

[4] The first illustrations of plants seem to have been introduced by Crateuas, personal physician to Mithridates VI of Pontus. Since illustrated diagrams were employed in zoology within the Lyceum (see, for example, *Generation of animals* 746a14ff. and *History of animals* 510a30ff.), it is surprising that they do not appear to have been adopted in botany, too.

[5] Op. cit., p. 134.

[6] For all of these see von Staden, 1989.